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CMS HCAL RBX Quality Check database

This database should be used for the data collecting during HCAL Readout Boxes electronics Quality Check tests. After the check is finished the valuable part of this information should be copied to the CMS Calibration Database and the content of the Quality Check DB (QC DB) could be recorded to a CD.

QC DB "boundary conditions"

CMS HCAL in total has 132 Readout Boxes (RBXs) distributed as follows

- 12 HF minus
- 18 HE minus
- 18 HB minus
- 12 HO wheel 1 minus
- 12 HO wheel 0
- 12 HO wheel 1 plus
- 18 HB plus
- 18 HE plus
- 12 HF plus

The HE, HB and HO RBXs are crates (shells) placed inside the HCAL and containing 4 Readout Modules (RMs), 1 Calibration Unit, 1 Clock and Control Module (CCM), High voltage and Low voltage units. HB and HO RBX have the same construction of shell and electronic units. HE RBX units have the same functionality as HB units but different mechanical construction.

The HF RBXs are placed outside CMS detector and therefore have different construction and different logical organization. It seems that HF electronics should be placed to a different database and in this note will be not discussed.

Each RM of HB/HO or HE type contains one Hybrid Photo-Diode which needs to supply two voltages (nominal voltages are 8 KV and 80 V) and 3 Front End (FE) boards with 6 analogous channels what gives 18 channels per RM. At the present moment we think that the replacement of broken FE boards will be done at manufacturer's laboratory so in our case the replacement unit will be a RM.

A Calibration Unit contains 2 similar analogous channels.

CCM does not contain any values to be stored to the Calibration DB. During RBX QC we expect to ensure that it works.

Low voltage and High Voltage units are passive modules.

All of these modules will be placed to the radiation area and therefore must be labeled by barcode labels for future tracing.

Each RM should pass through ~10 measurements (each measurement will be performed with different HPD HV settings and FE setting parameters, these parameters will be downloaded via HCAL Slow Control System). The result of these measurements is an array of floating point values with 18 channels' pedestal means and 18 channels' pedestal RMSs.

A Calibration Unit should pass 4 measurements and the result of each measurement is set of 2 values of pedestal means and 2 pedestal RMSs.

Some measurements could be repeated if an operator performing tests decides that something is wrong and the measurement should be redone.

We expect that the described DB should contain information about 108 RBXs and about ~600 electronics units (working units+10% of spares). Total amount of measurements is about 5000 and should contain about 200 000 floating point numbers.

We also think that the information containing HV, LV and temperatures inside RBX during measurement and error reports during FE downloading could be useful for QC and should be stored in the DB. This information will not go to the Calibration DB.

So the total size of the DB including HV and LV during measurements should not exceed 100 Mbytes (~3 Mbytes of calibration information + ~80 Mbytes for measurement conditions). The total size of raw data received from QC test-bench DAQ should not exceed 20 Gbytes. The raw data should be stored separately from the QC DB data and will not be recorded to the Calibration DB.

The measurement data will be taken by QC DAQ system running at a Linux computer. The QC test-bench Slow Control System will run at a Windows PC. Therefore the DB application program should read measurement-relevant data from both computers.

The DB should provide presentation a history of measurements for any of RMs or Calibration Units. It should also present values of pedestal means and RMSs in a convenient form.

The DB should have possibility to access corresponding records by reading a barcode labels from units with a barcode reader.

We think that the DB access time is not so important and typical time for a DB operation (reading of RM history, writing of a data of one measurement run) at level of 1 sec is good enough.

The DB should be accessed from QC test-bench laboratory in building 28 and from a PC (laptop?) at SX5. We plan to use CERN Oracle DB server to avoid DB maintenance by ourselves.

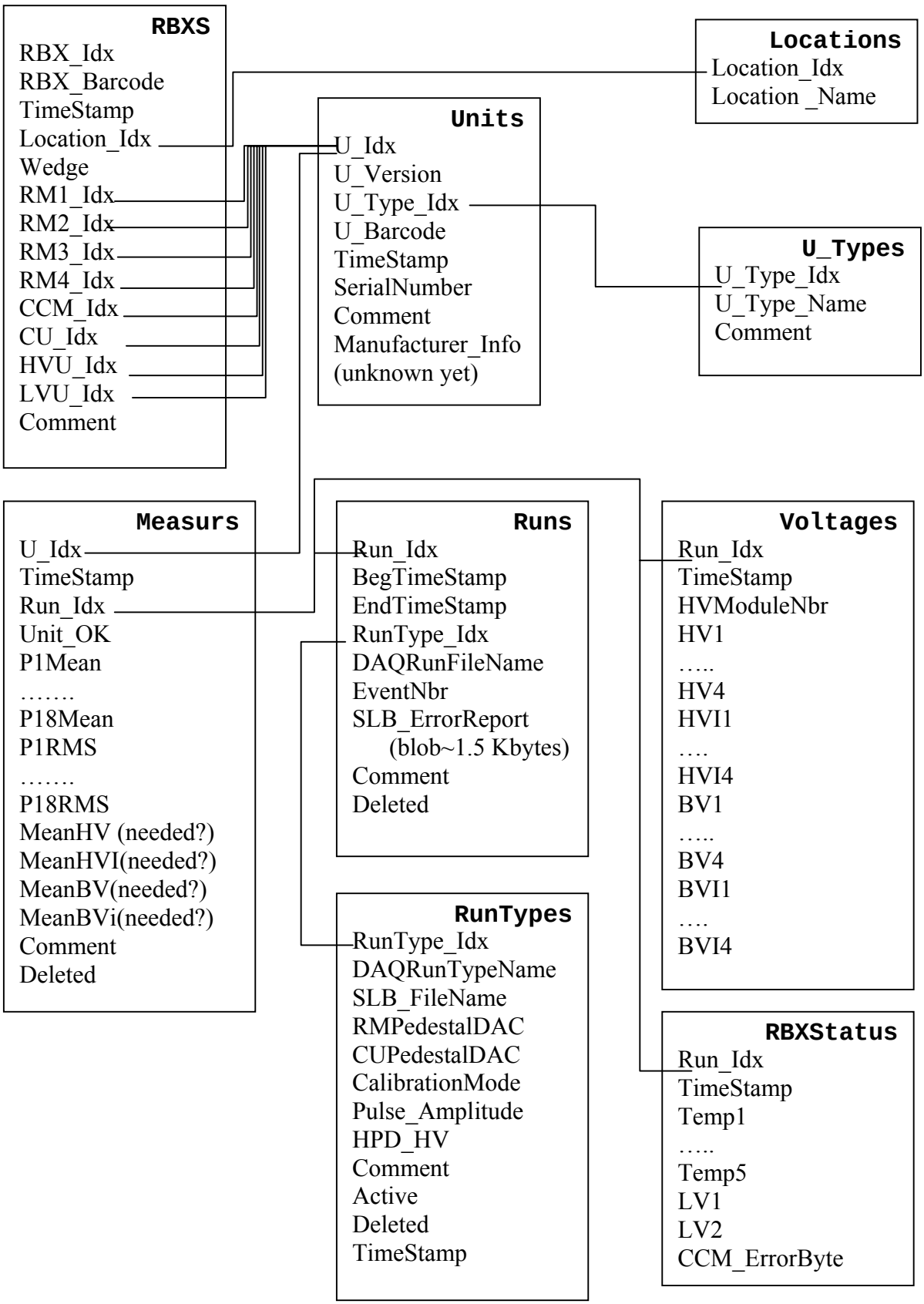
The DB should be ready in few weeks. We expect to get first RBXs for QC in March.

We plan to use Borlad C++ Builder and Delphi for Windows and Kylix for Linux because we have a lot of experience with these tools. These tools contain very vide set of visual components for DB access and browsing.

The main part of work with the HCAL RBXs QC information should be performed by the application programs build with general-purpose programming tools mentioned above and only simplest queries should be executed by DB server.

We plan to start development with local DB server like Borland Paradox and as soon as we get it running we will port it to Oracle. This migration takes few hours (it has been checked).

DB structure



DB tables

The table **RBXS** is used to establish parent/child relationship between RBX shells and units. It contains history of maps of the RBX. Because of the fact that some units could be replaced this table could contain more than 1 record for each RBX.

Fields

- RBX_Idx – index of RBX, autoincrementing.
- RBX_Barcode – barcode label. Ascii? Integer?
- TimeStamp – actual time of the record modification
- Location_IDX - actual location of RBX,equal to index of a record in a table **Locations** containing location names (could be HE-, HB-, HO-, HO0, HO+, HB+, HE+).
- Wedge – number of the wedge, 1..18, integer or char.
- RM1_Idx..LVU_Idx – indices of units in table **Units**.
- Comment – ASCII 80 characters

Table **Units**. Used to contain description of units and reparation history. Each unit could have only 1 record with equal U_Idx and U_Version. If unit has been repaired then the U_Version is incremented and the unit claimed to be a different unit.

Fields

- U_Idx – index of unit, autoincrementing.
- U_Version – version number of unit (see above).
- U_Type_Idx – index of type, refers to a table **U_Types** with type names (possible names are HB/HO RM, HB/HO Calibration Unit, HB/HO CCM, HB/HO Low Voltage unit, HB/HO High voltage unit, HE RM, HE Calibration Unit, HE CCM, HE Low Voltage unit, HE High voltage unit).
- U_Barcode – barcode label.
- TimeStamp – actual time of the record modification.
- SerialNumber – serial number of a unit (if available). Integer value. Today this information is defined for CCMs only.
- Comment – 80 ASCII characters
- Manufacturer_Info – possible information arriving with unit and not compatible with table Measurs containing unit measurements. Not defined yet.

Tables **Locations** and **U_Types** and their content are described above.

Table **Measurs** contains measured data for RMs and Calibration units and a Quality flag (“good”/”bad”) for other modules.

Table fields

- U_Idx – index of unit. Reference to table **Units**.
- TimeStamp – actual time of the record modification.
- Run_Idx – index of run, reference to table **Runs**.
- Unit_OK – quality flag (see above).
- P1Mean..P18RMS – 36 floating values of unit analogous channels pedestals means and RMSs.

- MeanHV..MeanBVI – mean values of HPD voltages and current during measurement. Not clear if needed but might be quite convenient. This information could be retrieved from table Voltages.
- Comment – comment for measurement, ASCII 80 chars.
- Deleted – logical. If flag is set then this record should not be visible for test-bench operator.

Table **Runs** contains information about QC test-bench DAQ runs.
Table fields

- Run_Idx – index of run, autoincrementing.
- BegTimeStamp – run beginning time stamp.
- EndRunTimeStamp – run end time stamp.
- RunType_Idx – index to table RunTypes containing run types description (see below).
- DAQRunFileName – name of a file at DAQ PC with raw data
- EventNumber – amount of triggers in the measurement run. Integer.
- SLB_ErrorReport – responses of CCM during parameter downloading. Array of bytes with floating length (expecting ~1.5 Kbytes). Should be recorded as BLOB.
- Comment – 80 ASCII characters
- Deleted – logical. If flag is set then this record should not be visible for test-bench operator.

Table **RunTypes** contains data taking conditions for typical measurements.
Table fields

- RunType_Idx – index, autoincrementing.
- DAQRunTypeName – ASCII string sent by the Run Control to Slow Control System at the run beginning. This string defines what measurement type is requested.
- SLB_FileName – filename of the FE parameter downloading binary file (Serial Link Binary file, SLB file). Later the SLB file will be generated "in the flight" from content RMPedestalDAC, CUPedestalDAC, CalibrationMode but for the beginning there will be real file used for parameter downloading.
- RMPedestalDAC – value of pedestal to be downloaded to RM channels. At the beginning this value is defined in the SLB file.
- CUPedestalDAC – value of pedestal to be downloaded to Calibration Unit channels. At the beginning this value is defined in the SLB file.
- CalibrationMode – calibration mode flag to be downloaded to RM channels. At the beginning this value is defined in the SLB file.
- PulseAmplitude – value of amplitude of test LED or Laser pulse.
- HPD_HV – a value of HV for all 4 RMs to be set during this type of run. Bias voltage should be set to 80 V.
- Comment – 80 ASCII characters.
- Active – logical. If run type list contains more than 1 record with the same content of DAQRunTypeName field then only one record could be active. When a new record of run type is created by default it becomes active.

- Deleted – logical. If flag is set then this record should not be visible for test-bench operator.
- TimeStamp – actual time of the record modification.

Table **`Voltages`** contains HV power supply information during data taking. Each record contains values for 8 source voltages and currents with timestamp. Data are read-out from the HV server. Read-out frequency is defined by the HV server and the maximum rate is ~1 measurement per second. Typical amount of information per run is few hundreds values.

Table fields

- Run_Idx – index of run in Runs table.
- TimeStamp – actual time of the record modification.
- HVModuleNumber – HV module number in the HV power supply.
- HV1..BVI4 – 16 floating point values of actual voltages and currents.

Table **`RBXStatus`** contains temperatures and voltages in RBX during data taking.

Table fields

- Run_Idx – index of run in Runs table.
- TimeStamp – actual time of the record modification.
- Temp1..Temp5 – temperatures inside RB units (floating point values).
- LV1, LV2 – power supply voltages at the RBX backplane (floating point values).
- CCM_ErrorByte – result of data readout (1 char).

Each record contains values for 5 temperatures, 2 voltages and the CCM I/O error byte with the timestamp.

Data are read-out from the CCM server. Read-out frequency is defined by the server and the maximum rate is ~1 measurement per second. Typical amount of information per run is few hundreds values.